STUDIES ON THE IMPACT OF ENVIRONMENT ON THE CHARACTERS OF SEEDS AND THE SUBSEQUENT CROP OF THE RICE VARIETY CHIANUNG NO. 242*

by

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INTRODUCTION

It has been the great concern for a breeder that a vareity released from his station will always maintain the same level of yielding ability at various places where it has been grown. Developmental variation, however, arises sometimes as a differential growth response in different environments. Under different soils and fertility conditions as well as different climatic conditions, a variety may behave quite differently. The occurrence of these variations through a period of time may be able to cause a great difference in the growth behavior and performance of a variety of the same origin.

Chianung No. 242 has been grown all over the island for years since it was released in 1954. There are complaints that this variety has already shown some kinds of deterioration. It is of great importance from the genecological standpoint to make sure that such variations really occurred and to determine whether these changes, if they do exist, are heritable.

Evidence is already at hand that environment can appreciably affect the quality of seed which in turn influences germination, growth, disease resistance, yield and other characters of succeeding crop. Actually, a concept has been prevailing that a certain place is paticularly suitable for producing high quality seeds for a specific crop.

This experiment was designed to (a) determine the type and nature of variation which might occur to the variety grown at various places and (b) measure the effect of source of seed on productivity and other related characters.

REVIEW OF THE LITERATURE

Kanda *et al.* (1952) reviewed the literature rather completely and found that individuals within a given variety of rice could behave quite differently in their phenotypes under various environments. Some of these ecological variations appeared to have genetical basis, even though most of these environmental variations were not heritable.

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Sakai (1954) estimated that a line or variety of rice is still heterozygous for almost 20% of genes controlling grain yield if it is assumed that genic pairs involved in the expression of yielding ability are around 50 and the line or variety is established at F9. In the first few generations after this line or variety is released, many of these minor genotypic variations may be lost because of selective elimination by the environment (Eliiott, 1958). Adair and Jones (1946) found that the desired combinations of agronomic characters survived in the bulk hybrid populations grown under different environmental conditions.

Noguchi (1958) reported to have successfully induced mutations from rice plants continuously grown under the condition of complete phosphorus deficiency. The mutability of plants was also reported to be greatly increased by keeping plants under the conditions of nitrogen and sulphur deficiency. Matsuo *et al.* (1959) also observed some variations on rice plants treated with nitrogen and phosphorus deficiency. However, these variations were later proved to be merely the after-effects of abnormal environments.

The Environment under which seeds are produced affects the growth of the succeeding crop. Nagai (1959) listed five factors which he regarded to be significantly related to the establishment of ecotypes and forms of rice. They are: (1) water requirement, (2) temperature, (3) the length of day during the growing season, (4) soil fertility and (5) salinity of soil and water. Matsuo *et al.* (1959) reported a significant influence of nutrients in rice; Went (1959), that of temperature in potato; Yamamoto and Wuematsu (1958), soil texture in carrot; Togari *et al.* (1954), soil fertility in soybean and Johnson (1954) observed the influence of light intensity in wheat.

The effects of seed quality on yield and other agronomic characters of the resulting crop were observed in rice (Tomo, 1951; Kanda *et al.*, 1952; Kido *et al.*, 1954; Matsuo *et al.*, 1956). in wheat (Waldron, 1941; Quinby *et al.*, 1962), in oat (Frey and Wiggans, 1956), in soybean (Suetsugu and Anaguchi, 1953; Ikeda, 1955), in potato (Went, 1959), in birdsfoot trefoil (Henson and Tayman, 1961), in Kentucky blue grass (Frakes, 1961) and in carrot (Yamamoto and Wuematsu, 1958). Generally, there was a correlation between large heavy seeds and high yields of the subsequent crop. Matsuo *et al.* (1956) found a significant difference in yield of individual progeny of large and small seeds in rice; but when the same weight of seed was planted, the difference tended to disappear.

Time of flowering in soybean (Ikeda, 1955) and heading date in rice (Kayama, 1953) were significantly affected by different sources of seeds. Tomo (1951) reported that significant differences occurred in the length of grain among different sources of seeds.

Quinby *et al.* (1962) reviewed the literature on the effect of source of seed to the resistance of disease and found that smut infection in oat and wheat was influenced by the environmental conditions to which the seed was exposed during the previous growing season. Suneson and Peltier (1936) found highly significant

winter hardiness differences within the same variety when different sources of seed were compared. Yamaguchi (1956) observed a difference in X-ray susceptibility among seeds of different sources of the same variety and attributed it to the change in physiological property of the seed.

MATERIALS AND METHODS

Seeds of Chianung No. 242, a Japonica variety of rice developed at this station were collected from various places where it had been growing for years. The seeds were sampled from the direct descendants of the original stock which came from this station. Attention was paid in sampling so that the sample in all could cover a wide range of environment. The sample thus collected was coded and the code number, source, history and environmental conditions of each sample are listed in table 1.

Table 1. Source, history and environmental conditions of samples collected.

Code No.	Source			Classes of seed	Original introduction		Soil texture	Soil fertility	Topography
	Region	Prefecture (City)	County		Year	Crop.			
1	Hsinchu	Hsinchu	—	foundation	1956	2nd.	loam	fertile	plain
2	Hsinchu	Hsinchu	Kuonlin	farmer's	1956	1st.	loam	moderately fertile	valley
3	Taichung	Taichung	—	foundation	1958	1st.	clay	mod. fertile	plain
4	Taichung	Nantou	Chusan	farmer's	1957	2nd.	clay loam	mod. fertile	valley
5	Taichung	Nantou	Chusan	farmer's	1959	2nd.	sandy loam	mod. fertile	valley
6	Taichung	Nantou	Puli	farmer's	1958	2nd.	loam	mod. fertile	valley
7	Taichung	Tsanghua	Tatsuan	farmer's	1956	2nd.	sandy loam	mod. fertile	plain
8	Taichung	Tsanghua	Fuenwen	farmer's	1958	2nd.	sandy loam	mod. fertile	plain
9	Taichung	Tsanghua	Shichou	farmer's	1959	1st.	sandy loam	mod. fertile	plain
10	Tainan	Chiayi	—	breeder*	1954	1st.	clay loam	fertile	hillside
11	Tainan	Chiayi	Chiayi	farmer's	1959	1st.	loam	mod. fertile	plain
12	Tainan	Chiayi	—	fundation	1959	1st.	loam	mod. fertile	plain
13	Tainan	Tainan	Iuchen	farmer's	1957	1st.	loam	mod. fertile	valley
14	Kaohsiung	Kaohsiung	Chochen	registered	1960	2nd.	loam	mod. fertile	seaside
15	Kaohsiung	Kaohsiung	Sinen	farmer's	1960	1st.	loam	mod. fertile	plain
16	Kaohsiung	Kaohsiung	Nito	farmer's	1960	2nd.	sandy loam	mod. fertile	seaside
17	Kaohsiung	Pinton	Nanchou	farmer's	1959	2nd.	sandy loam	fertile	plain
18	Kaohsiung	Pinton	Likan	farmer's	1960	2nd.	sandy loam	fertile	plain
19	Kaohsiung	Pinton	Wantan	farmer's	1960	2nd.	clay loam	fertile	plain
20	Taitung	Taitung	Tsusan	farmer's	1955	2nd.	clay loam	fertile	plain
21	Taitung	Taitung	—	foundation	1960	2nd.	sandy loam	mod. fertile	plain
22	Hualiem	Hualien	—	foundation	1961	1st.	sandy loam	mod. fertile	plain
23	Hualiem	Hualien	Luesuei	farmer's	1958	1st.	sandy loam	mod. fertile	plain
24	Kaohsiung	Pinton	Neipu	farmer's	1960	1st.	sandy loam	mod. fertile	plain
25	Taipei	Ilan	Sansin	farmer's	1961	1st.	loam	mod. fertile	valley

* Original stock used here as check.

Seeds from each sample were measured for weight of 1,000 grains, length, width and thickness of grain, germination percentage and rate before planting. On the day before transplanting, seedling length, width and number of leaves and number of lesions of rice blast disease on each seedling were recorded. Natural epiphytotic for rice blast disease was available during the early stage of growth, hence the percentage of the disease was taken for each sample at 35 days after transplanting. At the full ripe stage, plant height and number of panicles were recorded. Before harvesting, ten ears, each from one hill, were sampled and the following data collected: length, weight and number of grains per ear, length, width and thickness of grains and the weight of 1,000 grains. Grain yield was based on the total grain yield of each plot.

All data collected were subjected to the analysis of variance. Square root and arcsin transformations were made for the data of the number of lesions and percentage of blast disease respectively, before making the analysis, according to the method shown by Snedecor (1961).

Two treatments were included in this experiment: fertility and source of seed. With and without fertilizations were two levels of fertility treatment while 25 samples constituted source of seed. The amount of fertilizers used in fertilization treatment was 80, 40, 40 kilograms per hectare for N, P and K respectively. The experiment was arranged in a split-plot design with two levels of fertilization as the main plots on 4 replications and 25 samples as the sub-plots.

Each sample was planted in 4-row plot which was equivalent to 1/2,500 hectare. The distance between rows was 25 cm and the distance between hills within a row was 20 cm. Approximately five seedlings were planted in each hill.

This experiment was conducted on the second crop of 1963 at Chiayi Agricultural Experiment Station. It was seeded on July 20, transplanted on August 1 and harvested on November 26. Standard method of rice culture was followed during the growing period.

EXPERIMENTAL RESULTS

Influence of Environment on the Characters of Seed.

The means and F values from analysis of variance for characters of seed measured are summarized in table 2.

The analysis of variance showed highly significant differences among sources of seed in length, width and thickness of grains as well as weight of 1,000 grains. Apparently, the quality of seed was appreciably influenced by the environment to which the seed was subjected during its development. It was found that changes among three components of grain size i. e. grain length, width and thickness were not necessarily parallel among themselves. Lighter grains were shown to be generally related to smaller size of seed. However, no close association seemed to exist between size and weight in heavier grains. Among components of grain size,

Table 2. Average values for morphological and physiological characters of different sources of seed.

Code number of sources	Grain			Weight of 1,000 grains (g)	Germination (%)	
	Length (mm)	Width (mm)	Thickness (mm)		Percentage	Rate
1	0.708	0.309	0.183	23.80	97	86
2	0.723	0.327	0.225	31.12	90	18
3	0.722	0.317	0.188	27.02	95	78
4	0.717	0.324	0.194	29.51	98	70
5	0.714	0.321	0.203	29.80	94	72
6	0.721	0.316	0.191	27.70	99	61
7	0.721	0.321	0.200	24.58	100	76
8	0.738	0.332	0.185	27.48	97	86
9	0.710	0.318	0.186	28.46	99	82
10	0.712	0.335	0.197	29.72	100	53
11	0.726	0.322	0.226	28.54	96	68
12	0.731	0.318	0.189	26.39	93	81
13	0.722	0.317	0.188	28.01	96	83
14	0.731	0.324	0.194	27.30	100	96
15	0.730	0.321	0.194	27.66	100	98
16	0.723	0.317	0.192	27.11	100	98
17	0.710	0.325	0.206	27.12	98	96
18	0.717	0.307	0.190	27.60	100	94
19	0.724	0.321	0.191	26.84	99	99
20	0.720	0.315	0.212	27.64	74	6
21	0.710	0.321	0.218	29.94	95	79
22	0.724	0.319	0.215	29.10	98	25
23	0.717	0.314	0.219	27.40	95	13
24	0.716	0.313	0.215	27.31	98	61
25	0.728	0.330	0.220	30.16	100	78
Mean	0.720	0.320	0.201	27.89		
F value	4.83**	11.08**	36.62**	165.66**		
L.S.D. 1%	0.013	0.007	0.008	0.469		

** F value significant at 1% level.

width and thickness of seed appeared to be more variable than grain length, as indicated by larger F values associated with the former two characters than that of the latter. It was also revealed in the data that the former two components of seed size were more related to the weight of seeds.

Differences in both percentage and rate of germination were also indicated. The rate of germination was more variable than percentage of germination, suggesting that the former was more easily affected by the environment. The rate of germination also varied in samples with same total germination percentage.

Influence of Sources of Seed on the Characters of their Seedlings.

A summary of the data obtained from the measurements of seedling appears in table 3.

Highly significant differences occurred among sources of seed in all characters of the seedlings measured, indicating that sources of seed could considerably change the characters of seedlings. Within a sample, all characters of seedlings seemed to be well coordinated among themselves in their respective growth which even-

Table 3. Means and F values for the characters of seedlings resulted from different sources of seed.

Code number	Leaf		Length of seedling	No. of lesions of blast diseae on leaves
	Number	Width (cm)	(cm)	
1	5.10	0.47	23.02	1.28
2	5.00	0.45	23.48	7.24
3	4.70	0.40	21.24	2.35
4	4.70	0.41	22.05	2.53
5	4.30	0.35	20.21	0.51
6	4.10	0.31	15.97	0.25
7	4.50	0.41	19.26	0.28
8	4.60	0.40	20.65	0.59
9	4.40	0.39	20.93	0.37
10	4.55	0.36	19.48	0.69
11	5.00	0.48	22.48	0.56
12	4.85	0.41	20.05	0.28
13	4.80	0.41	21.68	0.64
14	4.30	0.35	20.50	0.25
15	3.90	0.38	22.26	0.08
16	4.70	0.44	20.26	1.07
17	4.10	0.37	20.82	0.23
18	4.55	0.39	18.94	0.51
19	4.40	0.34	18.61	0.19
20	4.15	0.38	21.82	0.61
21	3.40	0.38	19.18	0.35
22	3.80	0.42	19.84	0.66
23	3.90	0.38	23.13	1.04
24	3.30	0.46	18.71	0.04
25	3.90	0.39	20.02	0.23
Mean	4.36	0.40	20.58	0.77
F value	16.40**	2.62**	14.60**	16.80**
L. S. D. 1%	0.43	0.09	0.52	0.34

** F value significant at 1% level.

tually resulted in the significant difference of seedling growth. The height and number of seedlings were more variable than width of leaves. In general, sample No. 1 showed the best growth of seedlings while sample No. 6, the poorest.

The average counting of rice blast lesions per leaf ranged from a minimum of 0.04 lesion per leaf in sample No. 24 to a maximum of 7.24 lesions in sample No. 2, a difference which greatly exceeded the 1% level of significance. It was apparent that the number of lesions on leaves was not related to the growth of seedlings.

Influence of Sources of Seed on the Growth of the Succeeding Crop.

A number of important characters were measured during the growing period of rice plants. A summary of the data appears in table 4, while the F values obtained from the analysis of variance are presented in table 5.

Table 4 shows that rice blast infection of plants as indicated by the percentage of blasted leaf area ranged from 6.5% to 16.8% which fell under class 3 or "moderately susceptible" group according to the standard of classification currently employed by rice investigators. The difference among samples just failed to reach significance at the 5% level of probability. The rice blast infection was relatively light in the plots of no fertilization but it was heavier in the fertilized plots. The difference between fertilizations, however, was not significant.

Differences in plant height at 40 days after transplanting and full mature were significant at the 5% and 1% levels of probability, respectively. Plant height in sample No. 6 was the shortest at both stages, indicating a consistant change of this character through the whole period of growth. Fertilizations did not cause significant change of plant height among sources of seed at both stages.

A difference of 3 days in heading date as expressed by the number of days from transplanting to heading was observed among sources of seed. The differences was significant at the 1% level of probability. Heading date was also significantly delayed in the fertilized plots. The number of tillers per hill differed significantly among samples as well as between fertilizations. F value associated with difference between fertilizations was extremely large, indicating that this character was very sensitive to the environment. Highly significant differences occurred in both length and weight of panicles among samples. The weight of panicles seemed to be more variable than the length of panicles since F value associated with the former character was larger than that of the latter. It should be noted that fertilizations did not cause significant changes in these two characters of panicles.

No significant interaction between source of seed and fertilizations was observed in the characters listed in Table 4.

Effect of Sources of Seed on Yield, Components of Yield and Size of Seeds of the Subsequent Crop.

The average yield, components of yield and size of seed were recorded on the crop resulted from different sources of seed. The data are summarized in Table 6, while a summary of F values computed from these characters appears in Table 7.

Table 4. Average values of some agronomic characters of plants grown from different sources of seed.

Code number	Rice blast (%)	Plant height (cm)		Heading date	Number of tillers per hill	Panicle length (cm)	Panicle weight (g)
		40 days	Full mature				
1	11.5	83.2	110.0	57.6	10.3	24.3	5.3
2	12.6	77.2	108.6	57.8	10.4	23.0	4.9
3	14.4	82.0	110.9	57.9	10.4	23.7	5.0
4	14.6	78.0	110.1	58.5	10.8	23.3	4.8
5	16.8	79.9	110.2	57.6	10.8	23.7	4.9
6	12.9	75.6	104.2	59.0	10.7	21.5	4.7
7	10.6	81.4	110.1	55.6	11.8	23.5	4.9
8	11.0	78.7	108.2	58.0	10.8	23.0	4.8
9	12.5	80.3	109.8	57.8	10.5	23.6	5.1
10	14.1	80.8	111.7	58.9	10.5	24.1	5.1
11	13.1	84.4	111.9	57.4	10.7	23.8	5.1
12	15.1	81.1	111.8	57.9	10.3	23.8	5.0
13	16.1	82.8	110.1	57.4	11.6	23.9	5.3
14	13.6	82.1	112.7	58.0	10.8	23.8	4.9
15	6.5	82.2	109.0	58.9	12.6	22.9	4.6
16	10.4	80.5	110.5	58.6	11.5	23.0	4.7
17	9.6	81.1	108.4	57.6	11.5	22.8	4.0
18	14.1	80.5	110.6	58.0	10.6	23.9	5.1
19	10.3	81.6	111.8	58.4	10.7	23.8	5.1
20	10.3	82.1	110.7	58.1	10.7	23.2	5.0
21	13.0	79.0	109.8	58.0	10.3	23.2	4.9
22	12.3	80.0	108.8	58.0	10.4	23.1	5.0
23	11.8	80.9	109.3	56.9	9.6	23.9	5.2
24	14.0	80.3	111.5	58.6	9.9	23.1	4.8
25	13.4	79.4	109.4	58.4	10.3	23.9	5.1
Mean	12.5	80.7	110.4	58.0	10.7	23.4	4.9
L.S.D. 5%	—	3.6	2.5	1.1	1.1	1.4	0.4

Table 5. F values for comparisons of samples, fertilizations and interaction.

Source of variation	Rice blast infection	Plant height		Heading date	Number of tillers per hill	Panicle length	Panicle weight
		40 days	Full mature				
Samples	1.34	1.88*	3.62**	3.53**	2.72**	2.75**	3.41**
Fertilizations	9.65	1.41	7.25	25.89*	661.54**	0.04	4.04
S × F	1.33	0.78	0.99	0.51	0.86	0.82	1.38

* Significance exceeds 5% level of probability.

** Significance exceeds 1% level of probability.

Table 6. Average yield, components of yield, and size of seeds of rice plants grown from different sources of seed.

Code number	Grain yield (kg/ha)	Number of panicles per hill	Number of grains per head	Weight of 1,000 grains (g)	Size of grain		
					Length (mm)	Width (mm)	Thickness (mm)
1	4,755	9.5	172.0	31.3	0.724	0.309	0.208
2	4,160	9.4	161.6	30.2	0.717	0.309	0.209
3	4,430	9.6	161.6	30.1	0.720	0.308	0.206
4	4,293	9.5	163.7	28.2	0.719	0.307	0.207
5	4,143	10.0	159.1	30.2	0.720	0.309	0.205
6	3,950	9.5	153.0	29.1	0.711	0.301	0.206
7	4,273	10.2	161.5	29.8	0.728	0.310	0.210
8	4,138	10.3	155.0	29.8	0.719	0.309	0.206
9	4,158	9.8	165.1	30.3	0.720	0.309	0.210
10	4,208	9.5	162.7	29.8	0.715	0.304	0.208
11	4,445	9.8	169.7	29.7	0.721	0.309	0.208
12	4,260	9.7	169.5	29.3	0.715	0.307	0.208
13	4,435	10.4	171.4	30.0	0.721	0.309	0.210
14	4,333	10.0	165.9	29.2	0.723	0.308	0.209
15	4,213	9.5	153.8	29.0	0.723	0.306	0.210
16	4,105	10.5	160.7	29.2	0.718	0.307	0.205
17	4,358	10.7	144.4	28.3	0.711	0.305	0.205
18	4,265	9.9	166.9	29.9	0.718	0.306	0.208
19	4,140	9.8	170.5	29.3	0.715	0.306	0.204
20	4,363	9.5	165.1	29.4	0.713	0.310	0.209
21	4,230	9.5	162.3	29.9	0.717	0.306	0.207
22	4,140	9.1	161.6	29.6	0.722	0.308	0.206
23	4,570	9.0	164.4	30.9	0.725	0.308	0.212
24	4,208	9.7	158.3	29.5	0.721	0.308	0.208
25	4,348	9.7	164.4	30.3	0.717	0.304	0.206
Average	4,272	9.8	160.2	29.7	0.719	0.307	0.207
L.S.D. 5%	—	0.9	7.8	1.5	—	—	—

Table 7. Summary of F values for yield, components of yield and size of seeds.

Source of variation	Grain yield	Number of panicles per hill	Number of grains per head	Weight of 1,000 grains	Length of grain	Width of grain	Thickness of grain
Samples	1.47	1.61*	5.18**	1.69*	1.01	0.82	0.97
Fertilization	2.79	94.74**	6.45	0.52	0.23	0.27	8.25
S × F	1.11	1.29	2.51**	0.84	1.36	1.64	1.17

* Significance exceeds 5% level of probability.

** Significance exceeds 1% level of probability.

Table 7 shows that sources of seed did not cause a significant change in yield, although significant differences occurred in the three components of yield. Differences between fertilizations were not significant in yield and two components of yield i. e. the number of grains per head and the weight of 1,000 grains, while in another component of yield, the number of panicles per hill, the difference between fertilizations was highly significant, indicating that this character was very susceptible to the change of the environment. The interaction between sources of seed and fertilizations was highly significant in the number of grains per head. However, the interactions between the treatments were not significant in yield and the other two components of yield, namely the number of panicles per hill and the weight of 1,000 grains.

The length, width and thickness of grains were not significantly affected by sources of seed and fertilizations, although F value associated with the difference between fertilizations in the thickness of grains was considerably large. No significant interaction between the treatments was also evident in these three characters.

DISCUSSION AND CONCLUSIONS

It was observed that seeds taken from various parts of the island differed significantly in their morphological characters. This may be due largely to the difference in environment of the sampling places. Differences in environment at sampling places are quite great as one might suppose from the geographical locations. The extreme temperature and monthly mean length of day in hours differences are 5.1°C and 120 hours respectively in February and 4.2°C and 78.1 hours respectively in July. The patterns of change, however, are similar in both temperature and day length. Altitude and topography also vary considerably from mountaneous valleys to coastal plains, but variations in soil texture and soil fertility are rather small.

Seedlings, components of yield and several agronomic characters of rice plants were significantly affected by sources of seed, indicating that the environment under which seeds are produced affects the growth of plants that grow from them. The lighter seeds of sample No. 6 taken from Puli, Nantou prefecture gave the poorest growth of seedlings while the heaviest seed of sample No. 2 from Kuonlin, Hsinchu prefecture produced the best established seedlings, suggesting that the weight of 1,000 grains might be related to the growth of plants. Suetsugu and Anaguchi (1953) observed in soybean that the after-effects of seed was due primarily to the weight of seed. Kayama (1953) and Matsuo *et al.* (1956) also reported that large and heavy seeds of rice generally led to the production of well established seedlings. It is understandable that a heavier seed produces a better seedling since it may store more nutrients. Frey and Wiggans (1956) actually observed in oat that this initial "capital" has an effect upon the growth of seedling produced. It should be noted, however, that the lightest seeds of sample No. 1 from Hsinchu Agricultural

Improvement Station produced well grown seedlings. This may suggest that inner property of seed has been changed by the environment and this physiological response of seed which is not yet understood may also affect the growth of plants grown from different sources of seed. Quinby *et al.* (1962) reported that plants grown from the lightest seeds were not unusually low in production. Matsuo *et al.* (1956) suggested that activity of enzymes may be involved in the inner change of seed. Based on these observations, it seems logical to conclude that the environment changes not only morphological characters, but also physiological activities of seed and these changes of seed are equally important in their influence on the growth of plants.

It was clearly indicated that the growth of seedling was related to the growth of rice plants and grain yield. Seedlings of sample No. 6 which showed the poorest growth were also found to grow poorly in the paddy field and produced the lowest yield, while the best grown seedlings of sample No. 1 grew well in the field and gave the highest yield. Matsuwura (1948) also reported a similar case in rice that well established seedlings could increase yield from 21% up to 61%.

Differences in rice plants among sources of seed were highly significant for most of the characters measured. The results seem to indicate that these differences may not be entirely environmental fluctuations but may possibly include certain genotypic variations. From the genetical standpoint, a variety may not be completely homozygous for all pairs of genes it contains. It is theoretically possible that when a given variety is released, there still remains some minor genetic variation, even though obvious segregation is essentially complete. Chianung No. 242 has been grown for years under various environmental conditions which provide many types of ecological situations and condition of partial isolation. Therefore, it seems probable that certain minor genetic variations may be fixed or lost because of differential selection of the particular environment where the variety happens to grow. It is possible that different sources of seed tested in this experiment may have different genotypes for certain characters. This possibility was also discussed by Sakai (1954) and Elliott (1958), and some genetical variations were actually reported by Noguchi (1958) and Matsuo *et al.* (1959). However, it is still unknown whether variations among sources of seed observed in this experiment are heritable or non-heritable. Further investigation will be conducted to make this point clear.

Differences between fertilized and non-fertilized plots for each sample were not significant in most characters of the plant except heading date and number of tillers per hill. These observations seem to indicate that each sample of seed in itself may be quite stable and less variable as compared with the variation among sources of seed. The great variability of heading date and number of tillers per hill caused by fertilizations is not unexpected.

Difference in grain yield among sources of seed was not significant, indicating that after-effects of seed was not effective to change yielding ability of rice plant.

This result was similar to those reported by Kanda *et al.* (1952) and Matsuo *et al.* (1956). Nevertheless, 805 kg per hectare or nearly 20% yield difference still occurred between the highest and the lowest samples. Since grain yield is a quantitative character which depends upon the composite activity of multiple genes, and, as estimated by Sakai (1954) that a given variety is still heterozygous for a number of genes controlling grain yield, it seems reasonable to suspect that samples of seed may differ in their genetic constitutions. However, the difference in the genic formula may be of such a small magnitude to be of any significance. Therefore, it seems probable that Chianung No. 242 currently under cultivation at various parts of the island may still maintain a same level of productivity.

It is of interest to note that highly significant differences observed in components of yield did not lead to a significant difference in grain yield. The result may be explained that three components of yield may change in different directions in each sample, so that the positive effect brought about by one component of yield may be nullified by the negetive effect of another component of yield. As a result, the yield difference among samples may be considerably minimized.

Seeds from fertile plain were generally more productive than those from high altitude valley as reported by Matsuo *et al.* (1956). Since difference in yield among sources of seed was not significant, it would appear dangerous to assume that Hsinchu Agricultural Improvement Station was a better source of seed for Chianung No. 242 than Puli and elsewhere. Furthermore, it is still not known that high yielding ability of seeds from Hsinchu Station was caused by the morphological and physiological changes of seed or by genotypic variations of seed.

The average yield of six foundation seed samples from local Agricultural Improvement Stations was 4,337 kg per hectare while that of 19 samples from farmers was 4,258 kg per hectare. Although the difference was small, the importance of cultural techniques other than the environment involved in the quality of seed should be noted. In general, seeds from farmers were undesirable because of their high percentage of off-types.

The difference in rice blast susceptibility among sources of seed was not significant, indicating that Chianung No. 242 now growing at various parts of the island may have a same degree of resistance to rice blast disease. The average percentage of infection in seed samples from valleys was 14.4%, while that of samples from plains was 11.9%, with a difference of 2.5%. What caused the difference is not obvious. However, seeds produced at cool high altitude valleys seem to be less resistant to rice blast disease.

It was found that differences in length, width and thickness of grains were highly significant among sources of seed. However, when plants grown from these seeds were harvested and their grains measured, no difference was detected on these three characters. A conclusion seems to be reached, therefore, that variations caused by the environment on these three morphological characters of seed were

non-heritable and after-effects of the environment on these characters could not affect the next generation.

SUMMARY

Seeds of rice variety Chianung No. 242 were sampled from various places of the island and the data on characters of particular importance were taken from sampled seed, nursery, paddy field and harvested grains to measure the variations among samples and the effect of sources of seed on the succeeding crop. A total of 25 samples were compared on non-fertilized and fertilized plots with 4 replications arranged in split-plot design with two fertilizations as main plots and 25 samples as sub-plots. The experiment was carried out at Chiayi Agricultural Experiment Station on the second crop of 1963.

Seeds produced at different places were significantly different in morphological characters and there were some indications that certain physiological changes might also have taken place in different sources of seed. Differences in morphological characters of length, width and thickness of seeds disappeared after one crop cultivation at this station, but difference in weight of 1,000 grains still remained significant. The differences in the former three characters of seeds appear to be the environmental fluctuation which does not affect the next generation.

Statistically significant differences in seedlings, components of yield and most of the agronomic characters of rice plants grown from different sources of seed were obtained. The differences in these characters possibly include the after-effects of the environment during seed formation and genetical variations resulted from differential selection of the particular environment where the variety happens to grow. However, what actually caused the differences is not obvious.

Grain yield was not significantly affected by different sources of seed, suggesting that Chianung No. 242 now widely grown at various parts of the island may still have a same level of productivity. A tendency seemed to prevail for the foundation seeds to yield better than the seeds produced by farmers. It is still not clearly known that a given place was a better source of seed for this variety.

No significant difference in rice blast susceptibility was evident, indicating that Chianung No. 242 now under cultivation in Taiwan may still maintain the same degree of resistance to rice blast disease. However, seeds produced at cool, high altitude valleys seemed to be less resistant to this disease than those produced at coastal plains.

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水稻嘉農 242 號品種生態變異之初步調查

張　萬　來

摘　要

本試驗以探究水稻嘉農 242 號品種在各推廣區域有否因受自然環境，耕種制度以及栽培年代之不同而發生之變異爲目的，試驗分室內及田間兩方面進行，調查由全省各地收集該品種25個樣谷之各種有關性狀。田間試驗採裂區設計，以不施肥及標準施肥爲主區，25個樣谷爲副區，重複四次，本試驗於民國52年第 2 期作在嘉義農業試驗分所舉行，茲將所得結果摘要如下：

由不同地區，所得之嘉農 242 號品種間，其谷粒之粒長、粒幅、粒厚及千粒重，差異均極爲顯著。且發芽率及發芽勢亦有差異。粒長、粒幅、粒厚之差異在本分所經過一期作之後即見消失。故其變異原因似爲環境之影響，非屬遺傳性變異。

地區不同之嘉農 242 號品種，在秧苗，稻株各農藝性狀，均有顯著之差異存在。此種變異，可能包括由環境獲得之後作用及因環境而形成之遺傳變異，惟眞正變異原因，尙待查明。

不同地區之嘉農 242 號品種，其產量並無顯著之差異。由此推測，目前在本省各地栽培之嘉農 242 號品種猶有相等之生產力，就本試驗所得結果尙難確定某一地區較適合繁殖高生產力之稻種。

本試驗生育初期普遍發生稻熱病。在不同地區所得嘉農 242 號品種間，其葉稻熱病罹病率之差異不顯著。由此言喻，本省各地正在推廣之嘉農 242 號品種，對葉稻熱病似仍具有相同程度之抵抗力，但高海拔地區生產之稻種，其後代之抗病性似較平地生產者爲弱。